Disclosure of the invention

As for appliances utilizing metal ions having an antimicrobial effect, it is common to use an ion elution unit that elutes metal ions by applying a voltage between electrodes. For example, to add silver ions in water, an anode electrode made of silver is soaked in water together with a cathode electrode and a voltage is applied between them. A reaction of $Ag \rightarrow Ag^+ + e^-$ occurs on the anode and silver ions Ag^+ are eluted into the water. The elution of silver ions Ag^+ leads to the depletion of anode.

On cathode side, on the other hand, a reaction of $H^+ + e^- \rightarrow 1/2H_2$ takes place regardless of the material of the electrode resulting in the generation of hydrogen gas and the deposition of compound of calcium contained in water as a scale on the surface of the electrode. Chloride or sulfide of the component metal is also precipitated on the electrode surface. Consequently, after the electrodes are used for a long time, a thick accumulation of scale, chloride or sulfide are formed on the surface of the cathode electrode. This accumulation hinders elution of metal ions, leading to unstable elution of metal ions and uneven depletion of electrodes.

In view of the above mentioned, it is an object of the present invention to provide an ion elution unit that can elute metal ions having an antimicrobial effect stably and efficiently for a long time. Still another object of the present invention is to provide an appliance, a washer in particular, that can avoid an unfavorable influence brought by the growth of microbes by adding metal ions generated by the ion elution unit to water.

To achieve the above object, according to one aspect of the present invention, an ion elution unit is configured in the following manner. In an ion elution unit that generates metal ions by applying a voltage between electrodes by a drive circuit, the polarities of the

electrodes are reversed cyclically with a voltage application halt period placed in-between, and the eluted metal ions are either silver ions, or copper ions, or zinc ions. With this configuration, because of polarity reversal, scale or other substances precipitated during a cathode period are eluted during an anode period. This prevents accumulation of scale or other substances on the surface of electrode and ensures stable elution of metal ions. In addition, during the voltage application halt period between polarity reversal, the metal ions eluted from an electrode that was then an anode, can go far from the electrode. Thus, the metal ions do not return to the electrode where they have been eluted from even when the electrode is inverted to a cathode. As a result, electric power consumed in metal ion elution will not be wasted, moreover, the situation that the expected total amount of metal ions is not obtained can be avoided. Furthermore, when the ion elution unit is incorporated in an appliance, metal ions are evenly dispersed in water due to the existence of the voltage application halt period. Therefore, the antimicrobial effect of the metal ions is exerted evenly over a wide area. Furthermore, since the eluted metal ions are either silver ions, or copper ions, or zinc ions, an excellent sterilizing effect and an anti-mold effect of silver ions, copper ions and zinc ions can be utilized.

According to the present invention, in the ion elution unit configured as described above, application of a voltage to the electrodes is started after feeding of water is started. With this configuration, metal ion elution can certainly be started just after the start of voltage application to the electrodes, and the expected total amount of metal ion supply is obtained.

According to the present invention, in the ion elution unit configured as described above, the applied voltage is so varied that a constant current flows between the electrodes. As the amount of eluted metal ions is proportional to the current that flows between the

CLAIMS

1. (Canceled)

2. (Amended) An ion elution unit that generates metal ions from electrodes when a drive circuit applies a voltage between the electrodes,

wherein polarities of the electrodes are reversed cyclically with a voltage application halt period placed in-between, and eluted metal ions are either silver ions, or copper ions, or zinc ions.

3. The ion elution unit according to claim 2,

wherein application of voltage to the electrodes is started after feeding of water is started.

4. The ion elution unit according to claim 2,

wherein the applied voltage is so varied that a constant current flows between the electrodes.

5. The ion elution unit according to 2,

wherein current flowing between the electrodes is detected by a current detection means, and the drive circuit is controlled based on the detection data, and a check of operation of the current detection means is carried out before the application of a voltage to the electrodes is started.

6. The ion elution unit according to claim 2,

wherein current flowing between the electrodes is detected by a current detection means, and the drive circuit is controlled based on the detection data, and operation of the current detection means is started when a predetermined period of time passes after the application of a voltage to the electrodes is started.

7. The ion elution unit according to claim 2,

wherein current flowing between the electrodes is detected by a current detection means, and the drive circuit is controlled based on the detection data, and when the current detection means detects abnormal current, a warning means notifies it to users.

8. The ion elution unit according to claim 7,

wherein even if the current detection means detects abnormal current, the warning means does not notify users of the abnormality on condition that normal current has been detected at least once during an ion elution process.

9. The ion elution unit according to claim 2,

wherein current flowing between the electrodes is detected by a current detection means, and the drive means is controlled based on the detection data, and when the current detection means detects that the value of the current flowing between the electrodes is a predetermined level or under, the lengths of the voltage application period and/or the voltage application halt period or the ion elution period are adjusted.

10. An appliance that incorporates the ion elution unit as set forth in one of

claims 2 to 9 and uses water mixed with metal ions generated by the ion elution unit.

11. The appliance according to claim 10,

wherein the ion elution period is adjusted according to the amount of water used.

12. The appliance according to claim 10,

wherein the lengths of the voltage application period and/or the voltage application halt period are adjusted according to the amount of water used or the length of ion elution period.

13. The appliance according to claim 10,

wherein a flow rate detection means is provided to measure the volume of water flow in the ion elution unit, and the lengths of the voltage application period and/or the voltage application halt period or the ion elution period is adjusted based on the measurement.

14. An appliance that incorporates the ion elution unit as set forth in one of claims 5 to 9, and when the current detection means detects abnormal current, specified countermeasures are adapted.

15. The appliance according to claim 14,

wherein the specified countermeasure is a temporary stop of the appliance operation.

16. An appliance that incorporates the ion elution unit as set forth in one of claims 5 to 9, and when the current detection means detects that the value of the current

flowing between the electrodes is a predetermined level or under, the volume of water flow fed to the ion elution unit is reduced and the ion elution period is extended.

17. The appliance according to claim 10, wherein the appliance is a washer.

18. The appliance according to claim 11, wherein the appliance is a washer.

19. The appliance according to claim 12, wherein the appliance is a washer.

20. The appliance according to claim 13, wherein the appliance is a washer.

21. The appliance according to claim 14, wherein the appliance is a washer.

22. The appliance according to claim 15, wherein the appliance is a washer.

23. The appliance according to claim 16, wherein the appliance is a washer.

24. An ion elution unit that generates silver ions by applying a voltage between silver electrodes disposed in a water feed passage,

wherein polarities of the electrodes are reversed cyclically.